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10/791,334	03/01/2004	Gi Youl Kim	40004551-0025-002	2408
26263 7590 05/19/2010 SONNENSCHN NATH & ROSENTHAL LLP P.O. BOX 061080 WACKER DRIVE STATION, WILLIS TOWER CHICAGO, IL 60606-1080				
EXAMINER				
TUROC, DAVID P				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/791,334

Applicant(s)

KIM ET AL.

Examiner

DAVID TUROCY

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Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 April 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4,5,8,9,11,15,17,18 and 42-45 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4,5,8,9,11,15,17,18 and 42-45 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 4/2/2010
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/2/2010 has been entered.

Response to Amendment

2. Applicant's amendments, filed 4/2/2010, have been fully considered and reviewed by the examiner. The examiner notes the cancellation of claims 40-41 and 46. Claims 1, 4-5, 8-9, 11, 15, 17-18, and 42-45 are pending in the instant application.

Response to Arguments

3. Applicant's arguments filed 4/2/2010 have been fully considered but they are not persuasive.

4. The declaration under 37 CFR 1.132 filed 4/2/2010 is insufficient to overcome the rejection of claims based upon Park or Park in view of Matero as set forth in the last Office action for at least the reasons set forth below.

The declaration argues against the Park reference, stating that the process includes a growth rate larger than the maximum ALD growth rate and therefore must include some CVD reaction. The declaration then goes on to argue that this occurs

because of the absence of a purge. However, this is exactly the process steps taken in the present application. Claims 4 and 5 explicitly requires a process without a purge following exposure between the reactant gases. While the declaration alleges that the present claims are distinctly different than those of Park, the examiner can not locate this difference in this factual argument.

Additionally, the present claims include an "enhanced" ALD process and therefore this does not exclude the presence of some CVD reactions as argued in the declaration. Therefore the declaration is deemed as being narrowly drafted and the arguments therein are not commensurate in scope with the claims as drafted.

The applicant has argued against the Matero reference, stating that the reference discloses increase in deposition rate for large H₂O doses and Park discloses TMA doses will affect the deposition rate. The examiner again, notes that Matero clearly discloses the size of the dose of either TMA or H₂O are result effective variables and one would be able to adjust these amounts through routine experimentation. Also, Matero discloses that which is taught by applicant at Figure 8B.

the affidavit argues that Park is concerned with the effect of different doses of TMA and Matero discusses the effects of altering the H₂O and therefore one would not contemplate combining the teachings of these references. Initially, the examiner cannot locate any support for the narrow reading of the Park reference. While a single example discloses the different TMA pulses, the examiner can not locate any support that the reference itself is concerned with only modifying the TMA pulse length. Finally, Matero and Park, taken together, clearly discloses the film growth rate is dependent on the

amount of TMA and H₂O and the examiner maintains that one skilled in the art can, taking the references teaching together, determine the appropriate dose to deposit the desired film.

Finally, the affidavit fails to address the commonalities between the Park and present claims: the same process gases, no purge between the gas pulses, and the same pulse times (and the fact that the present specification discloses the dose amount is dependent on the pulsing time).

The applicants appear to argue that the present claimed limitations are unexpected, but there has been insufficient factual support for such a position because the factual showing is not commensurate in scope with the present claims, because the claims are open to all combinations of the precursor gases and the arguments and specification showings are merely directed at a narrow species of the broad claim.

The applicant's have argued against the Park reference, stating that the reference fails to reference a dose and therefore must necessarily result in saturated doses and therefore can not inherently meet the limitations of the claims. The examiner disagrees. Specifically, the applicants own disclosure states "one or both of the first and/or second chemically reactive doses may be applied for a time between approximately 0.02 to approximately 2 sec (appropriate for TE-ALD) or approximately 0.02 to approximately 0.5 sec (appropriate to STAR_ALD)." Specifically, the applicants own specification fails to disclose the metes and bounds of a saturated dose versus an unsaturated dose and merely states that the dose supplied depends on the time of pulses. Therefore since prior art discloses the same gases, the same pulse length, and

substantially the same process parameters, the examiner maintains that the prior art must necessarily have the same results. The applicant has not provided any factual evidence to support the position that the prior art is over saturated and therefore can not meet the present claims. Additionally, the specification does not give any guidance as to the dose that will result in the claimed results, absent statements relating the time of pulse to the dose. Therefore, given the fact that the specification states that the results will occur at doses supplied at certain times and gases and the prior art disclose the certain time and gases, the examiner maintains the position as above, unless the applicant is performing other process steps that are not being claimed and/or disclosed by the specification.

The applicants argue that it is impossible to conclude that Park is not operating at or beyond saturation, however, again the mere fact that certain prior art discloses saturation and over-dosing is known does not result in all doses of ALD in the prior art must be saturated or over dosed. The applicants have noted that TMA and H₂O doses supplied at certain pulse lengths meet the limitations as claimed and therefore since the prior art discloses such lengths and gases, the results must be the same. The applicant argues that the prior art fails to disclose a precursor dose and therefore it is impossible to conclude that Park is not operating at or beyond saturation. The examiner notes that the present invention does not discloses a precursor doses, except merely states an undersaturated dose, and then discloses that such is achieved by supplying gases at certain pulse lengths. These pulse lengths and gases are taught by the prior art.

The applicants remaining arguments directed at Park are not supported by any factual evidence on the record and therefore are merely deemed attorney speculation.

As for the arguments of Matero, the applicants argues that the prior art discloses that the larger water doses result in substantially higher growth rate and therefore the applicants argue that the prior art would lead one of ordinary skill in the art to use large water doses when seeking to increase the film deposition rate, not to use an under saturated dose. The examiner can not locate any factual evidence to support this position. Matero clearly discloses that the dose of water (i.e. the first precursor that has a longer saturation time) and TMA are result effective variables for depositing a aluminum oxide film, directly effecting the deposition rate of the film (see entire reference). Additionally, Matero discloses film uniformity for doses that are less then saturation (page 1) and therefore it would have been obvious to one skill in the art at the time of the invention was made to determine the optimal value for the precursor doses, including time, used in the process of Park, through routine experimentation, to provide the desired deposition rate taking into consideration the pulse times and the desired throughput. The adjustment of the doses is well within the skill of one ordinary in the art and therefore doing such to achieve a maximum film deposition rate as required by the claims would have been obvious to one of ordinary skill in the art at the time of the invention to achieve the greatest throughput and film deposition rate. Additionally, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to provide H₂O and TMA at the claimed pulse doses, since it has been held that discovering an optimum value of a result effective variable involves only

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routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Additionally, the examiner notes the process as taught by Matero includes times that are well within the disclosed ranges as claimed and deposition rates that are substantially within the range as claimed. At the very least selecting dose so as to reap the benefits of a maximum deposition rate would have been obvious to one of ordinary skill in the art to reap the benefits of increase film deposition efficiency and thus increase throughput, a substantial benefit desired in the semiconductor processing industry.

Additionally, at the very least, the examiner notes that the claimed invention does not require that the maximum deposition rate is achieved only that the process is for achieving a substantially maximum film deposition rate. The applicant argues that the Matero reference leads one of ordinary skill in the art to use large doses to achieve film deposition rates, however, figure 1 clearly discloses that the undersaturated water dose results in substantially the maximum deposition rate as required by the claims. Again at the very least, Matero discloses that the doses of the ALD components of H₂O and TMA are result effective variables, directly effecting the deposition rate and therefore it would have been obvious to have determined the optimum value of these parameters through routine experimentation. The applicants have provided no factual or persuasive evidence to rebut this finding of routine experimentation.

All other arguments, that are not specifically addressed above, are deemed moot because they are unsupported by any factual evidence on the record and therefore are merely attorney speculation.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 1, 4-5, 8-9, 15, 17-18, 42-45 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a first reactive precursor of H₂O and a second reactive precursor of TMA, does not reasonably provide enablement for all arrangements of a first and second precursors as claimed. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

The nature of the invention involves ALD reaction of a first and second reactive gases selected from a seemingly infinite number of layers, and using doses of a first and second precursors that will result in "substantially invariant" saturated deposition rate with increases in the second chemical precursors. The state of the prior art is silent to various precursor combinations capable of being utilized in such a manner and while the skill of one ordinary in the art is relatively high, the claims required a chemical reactions and evaluating dosing which is a highly exact science with little predictability. Additionally, while the specification clearly describes with sufficient specificity the application of the species of Water (first) and TMA (second) without purges (only two examples - 1.0s and 0.1s pulse of H₂O without a purge in between, see Fig 8A) are

disclosed in having the results as claimed, the specification fails to include any working examples or direction as to a representative number of species of the seemingly infinite number of possible precursor combinations that would result in the invariant deposition rate as claimed without undue experimentation. This undue experimentation would encompass determining which first material has a longer saturation time, the doses required to meet the claim limitations and then which gases will provide the claimed deposition rate when used in combination according to the claim limitations. See *In re Wands*, 858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988).

7. Claims 1, 4-5, 8-9, 11, 15, 17-18, 42-45 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The claims require that the "substantially invariant over increase in the dose of the second chemically reactive precursor"; however there appears to be insufficient support for this broad limitation. Figure 8A clearly shows an increase in the deposition rate and it is unclear how the figure can establish that the TMA pulse as claimed. Additionally, the specification provides only two examples (1.0s and 0.1s pulse of H₂O without a purge) and the substantial invariant increase only occurs at a point in the process after an increase has occurred.

Claim Rejections - 35 USC § 102/103

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

9. Claims 1, 4-5, 8-9, 11, 15, 17-18, and 40-46 are rejected under 35 U.S.C. 102(a)/103(a) as being anticipated by or unpatentable over US Patent Publication 20020160585 by Park et al., hereafter Park.

Park discloses a method for forming a film by ALD method including exposing the first precursor dose to the substrate, thereafter exposing the wafer to the second chemically reactive group to provide a uniform coating (figures, 0086). Park discloses supplying a first and second reactant without a purge, multiple times, and discloses a first reactant for 0.5 seconds and a second reactant for 1 second (0086, figures). Park discloses TMA and H₂O as the reactants respectively (0086).

Park discloses all that is taught above, as for the requirement regarding the second precursor exhibiting saturating characteristics, however, as discussed above, Park discloses the claimed TMA and H₂O and therefore atleast the first precursor exhibits saturating characteristics as required by the claim. Park fails to disclose the requirement of film growth rate at a maximum value. However, the Park teaches each and every process step and limitation of the applicant's claims, including the length of time for introducing the precursors into the process chamber as well as the claimed reactants. Since the dose that results in maximum growth rate as in the applicant's

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claimed process is disclosed as simply a function of the precursors utilized and the length of pulses, and Park teaches the claimed process steps (including equivalent times and process gases), Park would have inherently produced a dose sufficient to results in a film growth rate at a maximum value unless essential process steps and/or limitations are missing from the applicant's claims.

Park fails to disclose a dose of the first or second precursor insufficient to result in maximum deposition rate or starved deposition. However, the Park teaches each and every process step and limitation of the applicant's claims, including the length of time for introducing the precursors into the process chamber as well as the claimed reactants. Since the dose insufficient to result in maximum deposition by the applicant's claimed process is disclosed in the disclosure as simply a function of the precursors utilized and the length of pulses, and Park teaches the claimed process steps, Park would have inherently produced a dose insufficient to result in maximum deposition unless essential process steps and/or limitations are missing from the applicant's claims.

Since the dose that results in maximum growth rate as in the applicant's claimed process is disclosed as simply a function of the precursors utilized and the length of pulses, and Park teaches the claimed process steps (including equivalent times and process gases), Park would have inherently produced a dose sufficient to results in a film growth rate at a maximum value unless essential process steps and/or limitations are missing from the applicant's claims. The mere observation of still another beneficial result of an old process cannot form the basis of patentability. *Allen et al. v.*

Coe, 57 USPQ 136; *In re Maeder et al.* 143 USPQ 249. Therefore the fact that Park does not explicitly state that the process gases are supplied at a dose that results in maximum saturated deposition rate does not disqualify the reference because Park does disclose the claimed process steps (including equivalent times and process gases). At the very least selecting dose so as to reap the benefits of a maximum deposition rate would have been obvious to one of ordinary skill in the art to reap the benefits of increase film deposition efficiency and thus increase throughput, a substantial benefit desired in the semiconductor processing industry.

As for the added limitation "substantially invariant over increase in the dose of the second chemically reactive precursor", per above, Park discloses the same precursors (TMA and H₂O) and discloses or makes obvious the pulsing dose as claimed and therefore Park would have inherently produced a the claims results unless essential process steps and/or limitations are missing from the applicant's claims. The mere observation of still another beneficial result of an old process cannot form the basis of patentability. *Allen et al. v. Coe*, 57 USPQ 136; *In re Maeder et al.* 143 USPQ 249.

Claims 2-3: These claims are discussed above.

Claims 4-5: Park discloses repeating first and second precursor pulses without a purge between them (0086).

Claims 8-9: Park discloses purging between reactive gases is known and suitable in the ALD art (0022). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of

obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Claim 11: Park discloses TMA and H₂O as the reactants respectively (0086).

Claim 15: Park discloses a first reactant for 0.5 seconds and a second reactant for 1 second (0086).

Claim 17: Park discloses delivering reactants substantially uniformly over the wafer (figures).

Claim 18: Park discloses repetition of first and second reactants (0086).

Claim 42: Park discloses a uniform film and the same gases/times as claimed and therefore it is the examiners position that the film as taught by Park will have the uniformity as claimed unless the applicant is performing process steps that are not presently claimed.

Claims 43: Park discloses a showerhead as claimed (see figures, where a gas distribution means as taught by Park can reasonably be considered a showerhead as claimed).

Claim 44: Park discloses all the process steps as claimed, i.e. Park discloses a uniform film and the same gases/times as claimed and therefore it is the examiners position that the saturated deposition rate of the TMA as taught by Park will have the same properties as those claimed unless the applicant is performing process steps that are not presently claimed.

Claim 45: Park discloses no purge between the substrate, i.e. a minimum controllable tolerance time.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 1, 4-5, 8-9, 11, 15, 17-18, and 40-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park as taught above in view of Matero et al. (Effect of water does on the atomic layer deposition rate of oxide thin films).

Park discloses all that is taught above and while the examiner maintains the position with regards to the process of Park inherently having the features as claimed because the references discloses all the same precursors and times that the specification discloses as providing the claimed benefits, the examiner cites here Matero et al., which explicitly discloses that the dose of water (i.e. the first precursor that has a longer saturation time) and TMA are result effective variables for depositing a aluminum oxide film, directly effecting the deposition rate of the film (see entire reference). Additionally, Matero discloses film uniformity for doses that are less then saturation (page 1) and therefore it would have been obvious to one skill in the art at the time of the invention was made to determine the optimal value for the precursor doses, including time, used in the process of Park, through routine experimentation, to provide the desired deposition rate taking into consideration the pulse times and the desired throughput. Additionally, it would have been obvious to a person having ordinary skill in

the art at the time the invention was made to provide H₂O and TMA at the claimed pulse doses, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Additionally, the examiner notes the process as taught by Matero includes times that are well within the disclosed ranges as claimed and deposition rates that are substantially within the range as claimed.

Additionally, adjusting the precursor doses to achieve the maximum film deposition rate would have been obvious to one of ordinary skill in the art to reap the benefit of improved throughput.

As for the added limitation "substantially invariant over increase in the dose of the second chemically reactive precursor", per above, Park and Matero discloses the same precursors (TMA and H₂O) and Matero discloses the dose of the precursor material is a result effective variable and therefore makes obvious determining the optimum value through routine experimentation, the dose as claimed and therefore Park in view of Matero would have inherently produced a the claims results unless essential process steps and/or limitations are missing from the applicant's claims. The mere observation of still another beneficial result of an old process cannot form the basis of patentability. *Allen et al. v. Coe*, 57 USPQ 136; *In re Maeder et al.* 143 USPQ 249.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DAVID TUROCY whose telephone number is (571)272-

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2940. The examiner can normally be reached on Tuesday, Thursday, and Friday from 7 a.m. - 6 p.m., Monday and Wednesday 5-8 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David Turocy/
Primary Examiner, Art Unit 1792